

PATENT SPECIFICATION

(11) 1 226 333

NO DRAWINGS

(21) Application No. 13546/67 (22) Filed 22 March 1967

(23) Complete Specification filed 22 March 1968

(45) Complete Specification published 24 March 1971

(51) International Classification C 04 b 11/14

(52) Index at acceptance

C1A D45 G47 G47D45

C1H D2 D5 DX

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(54) CAST GYPSUM PLASTER ARTICLES

(71) We, BPB INDUSTRIES LIMITED, a British Company, of Ferguson House, Marylebone Road, London, N.W.1, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to precast gypsum sheets, slabs and blocks.

Such articles of cast gypsum plaster, e.g. gypsum plasterboard, have a tendency, in the presence of significant free moisture, to deform when stressed due to a phenomenon known as "plastic flow." Plastic flow, which may occur even under the weight of the article alone, is to be distinguished from the virtually instantaneous elastic deflection which occurs for example when a load is applied to a beam. The latter phenomenon obeys well known physical laws, is entirely predictable, and is unimportant in comparison with the plastic flow which can occur in unfavourable circumstances. Plastic flow occurs slowly and increases in magnitude with time although eventually it tends to reach a limiting value. This effect does not obey any known physical laws, nor is the extent to which it will occur predictable. It is known that a number of factors can lead to increases in the amount of plastic flow recorded, especially the uptake of excessive amounts of moisture such as would occur with poor storage on site in wet or damp weather, exposure to rain or the formation of condensation on the boards when the air temperature drops at night, in unsatisfactory job conditions where humidities are high and ventilation is poor. (This latter effect could occur either during storage or after erection). Plastic flow is negligible when the plasterboard is dry or virtually dry or when proper precautions have been taken to avoid incidence of the adverse conditions mentioned above.

It has now been found that precast gypsum plaster sheets, slabs and blocks containing tartaric acid have a greater resistance to plastic flow than similar articles not containing tartaric acid.

Accordingly the present invention provides a precast gypsum plaster sheet, slab or block in which the set gypsum contains tartaric acid and also a method of preparing a precast gypsum sheet, slab or block from plaster in which tartaric acid is included in the mix to be cast so that it subsists in the set sheet, slab or block.

The tartaric acid can, for example, be added as a solid to the plaster or dissolved or dispersed in the water used in forming the mix.

The total amount of tartaric acid in the set product preferably ranges from 0.005 to 0.2 weight percent based on the dry plaster used in the mix, the most preferred range, particularly for plasterboard, being 0.01 or 0.03 to 0.09 or 0.10 weight percent. The particularly preferred range for tartaric acid in plasterboard is from 0.03 to 0.06 or 0.07 weight percent.

The tartaric acid addition appears to have no undesirable side-effects, and retains its efficiency in restricting plastic flow when used in conjunction with the usual setting accelerators (e.g. mineral gypsum, ground set gypsum, potassium sulphate and mixtures thereof) and other additives (e.g., starch, foam) conventionally used on plasterboard plants. The mix may be formed, cast and set under non-alkaline conditions.

The following examples illustrate the improvement in plastic flow resistance brought about by the presence of tartaric acid. In the Examples the percentages quoted are by weight based on the weight of dry plaster used in the mix, and unless otherwise stated the results are those obtained after a test period of three weeks. The sag in each case is measured as the vertical distance through which the region of the beam midway between the points, which support the ends of the beam, descends from the position initially occupied by the mid-point on erection.

EXAMPLES 1 TO 9

A number of tests to determine the efficiency of tartaric acid as an inhibitor of sag due to plastic flow were carried out in the laboratory.

In these tests the plaster-water slurry was sometimes aerated as when making plasterboard, while on other occasions simple plaster-water slurries only were used. In practice it is usual to add a preformed foam to the slurry when making plasterboard. A number of foaming agents are used, two of particular importance being designated Resin Soap and "Teepol" (Trade Mark). Resin Soap is based on natural pine tree resin, which is converted to a soap by the use of alkali, while "Teepol" foaming agents are based on sodium secondary alkyl sulphates and sodium benzene sulphonates. In practice it was found that tartaric acid was equally effective in the presence of either of these foaming agents or no foaming agent at all. Only simple plaster beams were cast and no attempt was made to prepare plaster-

board, i.e. a sheet of set plaster between, and adhering to, two sheets of paper. The sag tendencies of the beams after drying at 40°C were tested by simply supporting them at 18" centres, i.e., at points 18" apart in an atmosphere of 90% r.h./20°C. It is now known that this method gives results which, when compared with control bars containing no additives, somewhat enhances the relative effects compared with site conditions using plasterboard proper. However, the method is still comparative and indicative and is useful because of its simplicity. Typical results obtained during a number of tests over the periods stated with different plasters in the laboratory are given in the following Table 1:

Example	% Tartaric	% of Sag of Control	
	Acid Nil	Beams 100	
		After 1 week	After 3 weeks
1	0.001	84	83
2	0.002	71	68
3	0.005	53	51
4	0.01	45	20 — 45
5	0.020	33	29
6	0.03		15 — 35
6a	0.04		23 — 50
7	0.05		9 — 26
8	0.06		17 — 35
9	0.09		24 — 31
9a	0.10		16

The marked improvement in sag resistance at all levels of addition of tartaric acid is easily seen from these results. While the invention applies to a wide range of tartaric acid addition these conditions indicate that from 0.01 to 0.10% by weight based on the plaster will normally be preferred. The different degrees of improvement from example to example, and within some of the individual examples, is due to the fact that each example covers a number of tests conducted with different plasters and mixes.

EXAMPLES 10 TO 14

Plant trials have been carried out in two ways. The tartaric acid has been added either as a solid to the plaster feed or as a solution to the main water feed and the two methods have been found to be equally effective.

The following results were obtained when the plastic flow tendency of production plaster boards containing tartaric acid was compared with that of control boards which contained no additive. Pieces of each type of plasterboard were simply suspended at 18" centres for these tests in an atmosphere of 90% r.h./20°C for three weeks.

TABLE 2

Example	Amount of Tartaric Acid	% Sag of Control Boards
	Nil	100
10	0.01	69
11	0.02	45
12	0.04	35
13	0.06	36
14	0.09	27

The board being produced was normal quality production board except for the tartaric acid addition. The dry board weight was about 1750 lbs./1000 sq. ft. and was adjusted in the normal way by the addition of a preformed foam. The foaming agent used was of the "Teepol" type. The usual amounts of a starch bonding agent were also added to the slurry to make the plasterboard.

EXAMPLE 15 AND 16

The above examples all relate to testing in

damp air. Work has also been done which shows that even when wet with liquid water the improvement in sag resistance is not impaired. For example, whole boards were nailed to joists at 16" centres and some were sprayed with water over a period of 5 days, the total amount of water applied to the boards during this time being about 300 g./sq.ft. The boards were maintained in an environment of at least 90%rh/20° C in between spraying operations. The results obtained were:—

TABLE 3

Example	Amount of Tartaric Acid in Board (%)	Condition of Board	% of Sag Control Boards
15	0.06	Wetted	41
16	0.06	Not wetted	48

EXAMPLE 17

Smaller pieces of board measuring 20" x 2" were cut from whole boards as used in Examples 15 and 16 and allowed to soak in water in the laboratory. When freely supported at 18" centres these also sagged on average to about 35—40% of the extent to which pieces of control board sagged. This compares with the 36% obtained for non-soaked boards in an atmosphere of 90% r.h./20° C.

WHAT WE CLAIM IS:—

1. A precast gypsum sheet, slab or block in which the set gypsum contains tartaric acid.
2. A plasterboard in which the set gypsum core contains tartaric acid.
3. A precast article according to claim 1 or 2 wherein the set gypsum contains from 0.005 to 0.2 weight percent of tartaric acid based on the dry plaster used in the mix.

4. A precast article according to claim 3 wherein the set gypsum contains from 0.01 to 0.1 weight percent of tartaric acid based on the dry plaster used in the mix.

5. A precast article according to claim 4 wherein the set gypsum contains from 0.03 to 0.09 weight percent of tartaric acid based on the dry plaster used in the mix.

6. A precast article according to claim 5 wherein the set gypsum contains from 0.03 to 0.07 weight percent of tartaric acid based on the dry plaster used in the mix.

7. A precast article according to claim 6 wherein the set gypsum contains from 0.03 to 0.06 weight percent of tartaric acid based on the dry plaster used in the mix.

8. A method of preparing a precast gypsum sheet, slab or block from a water / plaster mix in which tartaric acid is included in the

- mix to be cast so that it subsists in the set product.
9. A method according to claim 8 wherein the tartaric acid is incorporated as a solid in the plaster.
10. A method according to claim 8 or 9 wherein the tartaric acid is included in the water for forming the mix.
11. A method according to any of claims 8 to 10 wherein the total amount of tartaric acid employed ranges from 0.005 to 0.2 weight percent based on the dry plaster used in the mix.
12. A method according to claim 11 wherein the total amount of tartaric acid employed ranges from 0.01 to 0.1 weight percent based on the dry plaster.
13. A method according to claim 12 wherein the total amount of tartaric acid employed ranges from 0.03 to 0.09 weight percent based on the dry plaster.
14. A method according to claim 13 wherein tartaric acid is employed in an amount of from 0.03 to 0.07 weight percent based on the dry plaster used in the mix.
15. A method according to claim 14 wherein the amount of tartaric acid employed is from 0.03 to 0.06 weight percent based on the dry plaster used in the mix.
16. A method according to any of claims 8 to 15 wherein the mix is cast and set under non-alkaline conditions.
17. A method according to any of claims 8 to 16 wherein the cast article is a gypsum plasterboard.
18. A cast gypsum plaster article substantially as described in any one of Examples 1 to 6 and 7.
19. A cast gypsum plaster article substantially as described in Example 8 or 9.
20. A cast gypsum plaster article substantially as described in Example 6a or 9a.
21. A gypsum plasterboard substantially as hereinbefore described in any one of Examples 10 to 12.
22. A gypsum plasterboard substantially as described in Example 13 or 14.
23. A gypsum plasterboard substantially as described in Examples 15, 16 and 17.
24. A method of making a cast gypsum plaster article substantially as described in any one of Examples 1 to 6, 7 to 9, 13 and 14.
25. A method of making a cast gypsum plaster article substantially as described in any one of Examples 6a, 9a, and 10 to 12.
26. A cast gypsum plaster article prepared by a method according to any one of claims 9 to 17.

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